



## **PET as Soil Stabilization Material**

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**Abstract :** This project deals with complete analysis improvement of soil properties and its stabilization using plastic waste bottles [PET]. Improving an onsite soil engineering properties is known as soil stabilization. This technique of soil stabilization can be effectively used to meet the challenges of society. Since soil is a key element of this nature and all this basic needs of life such as food, clothes and houses are fulfilled by soil and use of plastic as soil stabilizer would reduce the amount of waste dumped in land, oceans and to reduce hazardous effects on environment. In present situation, stabilizing of soils is of almost importance in balamathi region on Vellore, which makes them suitable for various construction activities. Through this project laboratory investigation is carried out on sub grade soil sample admixed with plastic bottle strips at different percentages of 1% and 2% and they are tested to increase properties and behaviors of soil sub base by various experiments like specific gravity, sieve analysis, proctor compaction test, swell index test, unconfined compressive strength test and CBR test. Then the experimental data is analyzed to find out variation in properties of the plastic admixed soil with respect to soil sample.

**Keywords :** PET Strips, soil samples, CBR test, UCC test, proctor compaction test, free swell index test.

### **1. Introduction:**

For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve the required properties in a soil needed for the any construction work.

From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Ancient civilizations of the Chinese, Romans and Incas utilized various methods to improve soil strength etc., some of these methods were so effective that their buildings and roads still exist.

In India, the modern era of soil stabilization began in early 1970's, with a general shortage of petroleum and aggregates, it became necessary for the engineers to look at means to improve soil other than replacing the poor soil at the building site. Soil stabilization was used but due to the use of obsolete methods and also due to the absence of proper technique, soil stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and equipment, it is emerging as a popular and cost-effective method for soil improvement.

Here, in this project, soil stabilization has been done with the help of randomly distributed PET bottles obtained from waste materials and they are cut into small strips. The improvement in the shear strength parameters has been stressed upon and comparative studies have been carried out using different methods of shear resistance measurement.

## 2. Experimental Investigations:

### 2.1 Scope of Work:

The experimental work consists of the following step

- Specific gravity of soil
- Standard proctor compaction test
- Free swell index test
- Direct shear test
- Unconfined compression test
- California bearing ratio test

### 2.2 Materials

#### 1. Soil sample

Natural soil collected near the area of Bagayam, Vellore.

#### 2. PET bottle strips



**Table No. 1 Index and strength parameters of PET**

Behavior parameters	Values
Plastic type	PET strips
Specific gravity	>1
Average wide	1mm
Average length	10mm
Ultimate tensile strength	55 MPA
Modulus of elasticity	0.11-0.45GPA
Burning point	200 <sup>0</sup> C
Acid and alkali resistance	Very good

### 3. Tests conducted

The various index and engineering properties of the soil sample collected were determined first, using the various standard tests.

#### 3.1 Specific Gravity Test

The specific gravity (G) has been determined using Pycnometer as per IS 2720 (Part III/sec I) 1980.

#### 3.2 Standard Proctor Test

Standard Proctor Test has been conducted as per IS 2720 Part(XXVIII). The Dry Density has been determined and has been plotted against the corresponding water Content to find the Optimum moisture Content

and the Maximum Dry density.

### Test Specifications:

Volume of mould	=	1000cc
Hammer weight	=	2.60kg
Drop	=	310mm
Number of blows	=	25

### 3.3 Direct Shear Test

The angle of internal friction ( $\Phi$ ) and the Cohesion ( $c$ ) of the plane soil sample have been determined by conducting Direct shear Test. The normal Stress against Shear Stress curve has been plotted and the results have obtained from the curve.

### 3.4 Unconfined compression test

The unconfined compression test is usually used for measurement of an undrained strength of cohesive soil. The test has done with procedure conforming to Indian standards (IS 9143: 1979).

### 3.5 Free swell index test

Free Swell Index is the increase in volume of a soil, without any external constraints, on submergence in water

It is determined by the following way as per IS: 2720 (Part XL) - 1977.

## 4. Result and discussion

The tests results are summarized in Table 2 and table 3.

In table 2 the variation in the Optimum moisture contents, dry density, free swell index, specific gravity.

In table 3 California bearing ratio, unconfined compressive strength and direct shear test.

**Table 2:**

TESTS	Soil without plastics	Soil with plastics of 1%	Soil with plastics of 2%
Direct shear	7.2 KN/m <sup>2</sup>	12 KN/m <sup>2</sup>	15.5 KN/m <sup>2</sup>
UCC	0.24 Kg/cm <sup>2</sup>	0.41 Kg/cm <sup>2</sup>	0.66 Kg/cm <sup>2</sup>

**Table 3:**

TESTS	Soil without plastics	Soil with plastics of 1%	Soil with plastics of 2%
Sp.Gravity	2.632	2.65	2.684
Free swell index	6.66	7.8	8.2
OMC	12%	15%	18%
Dry density	1.579g/cm <sup>3</sup>	1.743g/cm <sup>3</sup>	1.846g/cm <sup>3</sup>

## 5. Conclusion:

After analyzing the test results it has been found that on adding plastic strips into the soil, there has been a positive impact on properties of soil in favor of road construction at balamathi region in Vellore. So use of plastic as soil stabilizer in road soil sub grade can be recommended as it increases the cbr value and make the sub grade impermeable and also use of plastic waste bottles in stabilization widely reduces the hazardous effect on environment .thus, the project is done successfully.

## 6. References:

1. Y.Yaswanth Kumar, M.Ramakrishnan and K.Mahesh, "Stabilization of soil by using lime and waste plastic fibers", *International journal of engineering research online*,vol.5,issue1.201Jan-feb,ISSN:2321-7758,<http://www.ijoer.in>
2. Satyam tiwari and Nisheetiwari, "Soil Stabilisation using waste fiber materials", *International journal of innovative technology & research*,Vol.4,Issue no3,2016 apr-may, ISSN 2927-2930.
3. Shiva Kumar, Vidyaranya V, ShravanBharadwak, Prathiba KN, &Yuvaraj. C, "Soil stabilization using waste plastic strips", *International journal scientific and research*, Vol.7, May 2016, ISSN: 0976 -3031
4. MahaHatemNsaif, "Behavior of Soils Strengthened By Plastic Waste Materials",*Journal of Engineering and Development*, Vol. 17, No.4, October 2013, ISSN 1813- 7822
5. A.K. Choudhary, J.N. Jha and K.S. Gill,A,"study on CBR behavior of waste plastic strip reinforced soil", *Journal for Engineering Research*, 15 (1), 51-57 (2010).
6. S. W. Thakare, S. K.Sonule,"Performance of Plastic Bottle Reinforced Soil",*International Journal of Engineering Innovation & Research*, Volume 2, Issue 3, ISSN: 2277 – 5668
7. V. Mallikarjuna, T. Bindu Mani, Soil Stabilisation using plastic waste,*International Journal of Research in Engineering and Technology* ISSN: 2319-1163 | ISSN: 2321-7308
8. Jasmine Varghese Kalliyath, Jithin Thomas JoyJenyMerin Paul, Antony Mathew Vadakkal, "Soil Stabilization using plastic fibers",*International Journal of Science Technology & Engineering* | Volume 2 | Issue 12 | June 2016, ISSN (online): 2349-784X
9. Tom Damion, Muhammad Ashique. M .E, Paul Immanuel Varkey, Keerthi P. S., Dr. Solly George, "Use of Plastic Bottle Strips as an Admixture in the Soil Sub-grade for Road Construction",*International Research Journal of Engineering and Technology (IRJET)*, E-ISSN: 2395 - 0056 Volume: 03 Issue: 04 | Apr-2016 [www.irjet.net](http://www.irjet.net) p-ISSN: 2395-0072
10. Raghu P.V, Mukherjee S. P. and ChakrabartiSankar, "Upgradation of geotechnical parameters by waste plastic admixture in soil",*Journal of Environmental Research and Development* Vol. 8 No. 3A, January-March 2014
11. IS: 2720(Part 2), 1973 Methods of Test for Soils, Determination of water content.
12. IS 2720(III/SEC-I): 1980 Methods of Test for Soils, Determination of specific Gravity.
13. IS 2720(VII):1980 Methods of Test for Soils, Determination of water content and dry density relation using light compaction.
14. IS 2720(XIII):1986 Methods of Test for Soils, direct shear test.
15. IS 2720(X):1991 Methods of Test for Soils, determination of UCC test.

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